STROKE and STEMI SYSTEM DETAILS:
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I. STROKE

Florida

- State-designated Primary and Comprehensive Stroke Centers
- State-listed primary and comprehensive stroke centers
- By June 1 each year, the Department of Health sends the medical director of each licensed EMS provider in the state a list of primary and comprehensive stroke centers
- The Department will develop and post a sample stroke triage tool for EMS providers; EMS must use a stroke-triage assessment tool similar to that posted
- The medical director of each licensed EMS provider must develop and implement assessment, treatment, and transport-destination protocols to take stroke patients to the most appropriate facility
- Primary Stroke Centers
    - Hospital must submit affidavit stating that it is certified by JCAHO as a primary stroke center OR that it meets the JCAHO criteria
    - Hospitals must establish specific procedures for screening patients for stroke, especially children
    - Centers should ensure appropriate transfer, especially for children
- Comprehensive Stroke Centers
    - The agency will establish criteria for CSC; if JCAHO establishes criteria the agency will establish similar criteria
    - Must establish specific screening procedures, especially for children
    - Must ensure transfer to specialized care for children and young adults
    - Hospitals must provide affidavit that it has received initial Primary Stroke Center designation
    - Hospitals must have the following for CSC status
        - A designated comprehensive stroke center medical director
        - Neurologists, neurosurgeons, surgeons capable of carotid endarterectomy, diagnostic and interventional neuroradiology
        - ED physicians and nurses trained in stroke care
        - Nursing staff for stroke units with specific training for overall stroke care
        - Nursing staff in the ICU with specific training in complex and/or severe neurological/neurosurgical conditions
        - Advanced practice nurses for neuro evaluation and treatment
        - Physicians with critical care training for neuro patients
        - Echo and ultrasound capability (including interpretation)
        - Rehabilitation capabilities
        - Multidisciplinary team approach
        - Neurosurgical expertise available 24/7, in house within 2 hours
        - Stroke neurologists available 24/7

        - Endovascular/neurointerventionalist on active full-time staff OR pre-arranged transfer agreements for rapid transfer to appropriate facility
        - Advanced diagnostic capabilities
        - Neurologic Surgery and Endovascular Interventions
        - Specialized infrastructure
            - EMS link- EMS leadership coordination and collaboration with CSC to ensure proper practice and facilitate inter-facility transfers
            - Referral and triage- a CSC must maintain
                - An acute stroke team available 24/7
                - A system for facilitating inter-facility transfers
                - Defined access telephone numbers in a system for accepting appropriate transfers
            - Inpatient units
                - Intensive care capabilities
                - Acute Stroke Unit
            - Rehabilitation and Post-Stroke Continuum of Care
            - Education- professional and community
            - Professional standards for nursing
            - Research
        - Quality Improvement and Clinical Outcomes Measurement
            - Multidisciplinary QI committee
            - Specific benchmarks
            - Outcomes review
            - Database and/or registry
            - Comparison to institutions across the US

North Carolina

- Statewide trauma and stroke system
    - System for identifying and disseminating information about location of primary stroke centers
    - Statewide trauma registry
    - Statewide stroke registry
    - Statewide educational requirements for both
    - Rules will include
        - Guidelines for monitoring and evaluating the systems
            - Standards and criteria for primary stroke centers and trauma centers
            - Regional peer review committees for each
    - Primary Stroke Center
        - Hospitals certified by JCAHO as a primary stroke center and hospitals identified North Carolina Medical Care Commission as a primary stroke center

New York State

- State-designated stroke centers
- Application process; final approval requires Department of Health site visit
- Posted list of Department of Health-approved Designated Stroke Centers
- Regional EMS Councils play role in education, implementation, and general communications with EMS agencies regarding stroke centers
- Appropriate stroke patients diverted past closer community hospitals to designated stroke centers (if the patient can arrive within 2 hours of symptom onset)
    - Transport to nearest ED for cardiac arrest, unstable airway, other medical condition warranting transport to nearest ED by protocol
- Pre-hospital assessment: Cincinnati Pre-Hospital Stroke Scale
- EMS personnel must contact stroke center as soon as possible to notify them of transport
- Receiving hospital must assemble stroke team
- Training/Education for all pre-hospital providers
    - CME CD-ROM from American Heart Association mailed to every EMS ambulance service and all first response services
    - Training provided by certified EMS instructor or agency training officer
    - Each agency must maintain record of in-house training with attendance sheet
    - Designated stroke centers are to assist with local training

Massachusetts

- Department of Public Health designated Primary Stroke Centers
- Point-of-entry plans adopted by Emergency Medical Services Regions
    - Direct ambulances to transport stroke patients to designated centers
    - Designated center ED's will establish lines of communication with EMS providers to ensure appropriate assessment and transport
- Regulations include
    - Application to the Department
    - Stroke Service Director or Coordinator
    - Written Care Protocols
        - Communication with EMS
        - Acute Stroke Team
        - Stroke Triage Plan
        - Time Targets for assessment
        - Protocols for telemedicine
    - ED Stroke Protocols
        - Include communication with EMS
        - Prompt activation of Acute Stroke Team
    - Thrombolytic Protocols
        - Pre-treatment
        - Treatment
        - Post-treatment
    - Post-Admission Care Protocols
    - Neuro-imaging services
    - Other imaging and EKG services

- Laboratory services
- Neurosurgical services
  - Evaluation
  - Consultation
  - Transfer (if applicable) in appropriate time
  - Transfer agreements (if applicable)
- Quality improvement
- Continuing Health Professional Education- pre-hospital and hospital
- Community Education
- Primary Stroke Service Review

New Jersey

- Two levels of stroke care: primary and comprehensive stroke centers
  - Primary Centers
    - Evaluate, stabilize, and provide emergency care to patients with acute stroke
    - Admit or transfer to comprehensive stroke center
  - Comprehensive Stroke Center
    - Coverage for patients with complex stroke requiring specialized testing, highly technical procedures, and other intervention
- Criteria
  - Primary Centers
    - Acute stroke team 24/7; able to see patient in 15 minutes of arrival
    - Written care protocols and standing orders for emergency stroke care
    - Neurology and ED personnel trained in acute stroke diagnosis and treatment
    - Neurosurgical services- on site or through transfer agreement with CSC 24/7
    - Provide acute care rehabilitations services
    - Maintain transfer agreements with CSC
    - Institutional commitment including designated physician stroke center director
    - Nuero-imaging services 24/7 within 25 minutes
    - Laboratory services
    - Outcomes and quality improvement activities
      - Database and registry
    - Annual continuing stroke education
    - Stroke director required to have minimum 8 hours of continuing stroke education each year
    - Community education
  - Comprehensive Stroke Center
    - Hospitals must meet all criteria for Primary Center
    - Maintain neurosurgical team capable of stroke assessment and management
    - Maintain neuro-radiologist and neuro-interventionalist

        - Provide comprehensive rehabilitation services on site or by transfer agreement
        - Maintain written transfer agreements with Primary Stroke Centers to accept transfer of complex patients
        - MRI/CT angiography/digital subtraction angiography capability
        - Neuro-interventional procedure capability
        - Outcomes assessment and performance improvement processes that incorporate data from affiliated Primary Centers
        - Provide graduate medical education in stroke
        - Conduct stroke-related research

Alabama

- Protocol directed Stroke Center Destination
- Patient transport to closest Stroke Center in the system with appropriate resources
- Regional stroke database
- Continuing Education
- Pre-hospital Component
    - Entry criteria and communications
    - Protocols for field care
- Hospital Component
    - Voluntary participation in system
    - Application process with on site visit
    - Standards developed by the Stroke Task Force
    - Neurologist must be primarily responsible for oversight of hospital stroke program
- Stroke Center Standards
    - Stroke Service and Director
    - Neurology, Neurosurgery or transfer agreement, Emergency Medicine
    - Specialty availability
    - Consultation availability
    - Emergency Department criteria for personnel and equipment
    - Adequately staffed operating suites
    - Post-anesthesia recovery
    - Intensive Care Capabilities
    - Neuro-imaging capability
    - Rehabilitation services on site or by transfer agreement
    - Clinical laboratory services
- Communications Component
    - Knowledge of overall status of pre-hospital stroke activities and hospital resource availability
    - Access to system organization and function protocols
    - Link between the field and Stroke Centers for rapid information exchange
    - Collection of uniform system-wide data for QI and regional database development
    - Central communication will be housed with Trauma Communications Center
        - Staffing 24/7 with personnel trained in the Regional Stroke System design, function, and protocols

        - Staff make no primary decisions, provide patient management information and destination based on protocol
- Data Quality Improvement Component
    - Small dataset with 10 fields (incident location, pre-hospital units, activity times, receiving hospital, patient and system demographics, pre-hospital outcome, hospital status/response, Emergency Department disposition, Initial (within first 24 hours) procedures, final disposition)
    - Regional QI committee
    - Hospital QI
    - Pre-hospital QI
- Stroke Implementation Committee
    - Development of operational protocols; forward to lead agency
    - Functional only in implementation period
    - Specific requirements for membership
- Stroke Operations Committee
    - Monitoring and primary management of system function
    - Directly responsible for reporting to lead agency
- Stroke System Functions
    - Field evaluation by EMT who determines if patient meets system entry criteria (also available from Communications Center)
    - Communications established with Communications Center
    - Triage status of and current Stroke Center activity status determine hospital destination
    - Direct patched communications link to closest active Stroke Center is provided by the Communications Center to the field EMT
    - Medical control is established through the communications link with the receiving Stroke Center, orders given
    - Transport to designated Center/completion of pre-hospital care
- System Entry Criteria
    - Pre-hospital screening
    - EMT discretion
- Communications
    - Knowledge of system-wide pre-hospital stroke activities
    - Knowledge of current status of functional capabilities of centers
    - Differential resource utilization
    - Specific data relayed (age and sex, entry criteria, estimated time of onset, major obvious problems, confirmation that patient does or does not meet system entry criteria)

Texas

- State recognized/designated stroke centers
- Application process to the DSHS
- DSHS will post designated centers
- Early Treatment Protocols for Rapid Transport
    - Written plan for regional triage
    - EMS to take patients to highest available level, state-designated Stroke Center

    - No more than 15 minute delay in going to next available center
    - Maintain registry of the number and destination of stroke patients, submit annually to DSHS
- Emergency Medical Services Training
    - Training on Cincinnati Stroke Scale use
    - Stroke recognition and emergency care training
    - Documented familiarity with the Stroke Center Certification and the Emergency Transport Protocol or their RAC
    - Medical Director of EMS personnel to oversee documentation of stroke training
    - Current ACLS certification be recognized as documentation of that training OR the supervising Medical Director be responsible for oversight, documentation, and attestation of equivalent training annually
- Community education of stroke plan
- Level 1: Comprehensive Stroke Center
    - Will meet requirements of Primary Stroke Center established by the Brain Attack Coalition
    - 24/7 stroke capabilities
    - Staff to include vascular neurology, neurosurgery, neuro-radiology, interventional neuro-radiology/endovascular physicians, critical care specialists, advanced practice nurse practitioners, rehabilitation specialists
    - Advanced diagnostic imaging
    - Capability to perform advanced surgical and interventional procedures
    - Supporting infrastructure 24/7
    - Educational and research programs
- Level 2: Primary Stroke Center
    - 24 hour stroke team
    - Written care protocols
    - EMS agreements and services
    - Trained ED personnel
    - Dedicated stroke unit
    - Neurosurgical, neurological, and medical support services
    - Stroke center director (MD)
    - Neuro-imaging 24/7 availability
    - Outcomes and quality improvement plan
    - Annual stroke CE requirement
    - Public education program
- Level 3: Support Stroke Facilities
    - Provide timely access to stroke care
    - May not be able to meet criteria for Level 1 or 2
    - Must develop plan specifying elements of operation they do meet
    - Have agreements with Level 1 or 2 centers for transfer with 24/7 access to necessary health professionals and resources
        - Written agreements specifying details of collaboration
    - Develop written treatment protocols
        - Transport/communications criteria with Level 1 or 2
        - Protocols for thrombolytics/other approved therapies

    - EMS/RAC agreement
        - Specify transport protocols
        - Specify alternate transport agreements
    - Document ED personnel stroke training
    - Designated stroke director
    - Use the NIHSS for evaluation of acute stroke patients (by certified individuals)
    - Designate availability of neurosurgical and interventional neuro-radiology/endovascular services
    - Document access and transport plan for unavailable services within 90 minutes of identified need
    - Be a licensed DSHS general hospital

Nevada

- JCAHO National Stroke Center Certification program
- Designated Stroke Centers
    - Acute Stroke Response Team
    - Written care protocols
    - Agreement with local EMS
    - Agreements with the Emergency Department
    - Stroke Unit
    - Neurosurgical availability
    - Stroke rehabilitation team
    - Support of hospital administration
    - Stroke Center Medical Director
    - 24 hour imaging and laboratory services
    - Outcome and Quality Improvement measurements
    - CME
    - Clinical Trials support team
- Standard pre-hospital protocols in all communities
- In-service of each rural hospital and EMS provider on protocols
- Tele-radiology for rural hospitals
- Public awareness campaign
- Ultimately will optimize telemedicine for evaluation of patients in rural hospitals

Tele-Stroke

New York/Georgia/Nevada

- Use REACH (Remote Evaluation of Ischemic Stroke System form GA)
    - ER physician with audio/video communication with stroke specialist from remote location
    - Tele-radiology for CT readings
    - NIHSS administered over tele-stroke system
    - Dedicated sites versus internet-based system; 100% web-based service
- Decision support for remote diagnosis and evaluation
- Real time interactive consultation with specialist
- Ability to start treatment in rural ED with guidance
- Grey areas
    - Liability
    - Physician credentialing
    - Clinical issues/standards of practice
    - Quality improvement
    - Financial reimbursement

II. STEMI

Pre-hospital Cardiac Triage Systems

- Urban and Suburban settings
- Pre-hospital 12-lead EKG
- Defibrillator capability/standard ACLS transport
- Paramedics authorized to divert to STEMI center
- The STEMI receiving center can go on diversion when at capacity
- PCI team activated by paramedic STEMI identification
- Fibrinolysis in ED if anticipated PCI delay >60 min and symptom onset <3 hours
- Multidisciplinary system/QA QI process

Inter-hospital Transfer System

- Rural and suburban settings within 200 miles of STEMI receiving center (hospital that performs primary PCI)
- Referring hospital identifies STEMI patient
- Defibrillator capability
- Standardized transfer protocols
- The STEMI receiving center can go on diversion if at capacity
- PCI team activated based on STEMI diagnosis by referring hospital
- Fibrinolysis in ED if delay to PCI >60 min and symptom onset <3 hours
- Multidisciplinary system/QA QI process

Recommendations from *Duke* (Waters, R. et all, J Am Coll Cardiol, 2004)

- Designation of centralized AMI centers
- Central AMI center within certain distance of referral hospitals
- Central AMI center should have PCI capability
- Development of AMI teams at community hospitals
- Central coordination and management of care at community and tertiary centers
- Quality monitoring
- Clinical research networks

Boston, MA (pre-hospital system)

- High risk patients identified in the field
- Patients classified as
    - STEMI- cath lab prepares; patient bypasses ED
    - Possible STEMI- cardiology reviews EKG before calling cath lab
    - Non-STEMI- go to nearest hospital
- Paramedic interpretation of pre-hospital EKG in the filed
    - Automated 12-lead EKG was found in large pre-hospital study to have lower sensitivity and higher specificity than 3 blinded cardiologists
- EMT contacts and transports patient to nearest PCI capable hospital
- Hospitals never on diversion

- Patients without ST elevation but with suspected acute cardiac ischemia transported to closest appropriate hospital (all hospitals listed as cardiac in point of entry plan so no patient loss to hospitals; PCI hospitals further designated)
- Formal QI process
- Frequent training sessions for paramedics
- One EMS provider agency with 60 paramedics
- Patients transported directly to best equipped and staffed hospital; bypass others
- Hospital designation as primary PCI center

Minneapolis, MN (Inter-hospital Transfer System)

- Level I Heart Attack program
- "Hub and spoke" system between Abbott Northwestern Hospital and 28 hospitals within 200-mile radius
- Zone 1 hospitals: <60 miles from PCI center
- Zone 2 hospitals: 60 to 210 miles from PCI center
    - Facilitated PCI protocol with reduced-dose fibrinolytics in anticipation of long transfer times
- Spoke hospital should always be able to provide on-site fibrinolysis
- ED physician diagnosis STEMI and activates system with one phone call
- Coordinated hospital-specific transport plan
- Standardized treatment protocol with pre-printed standing orders initiated
- Each hospital has Toolkit with
    - Protocol checklist
    - Transfer form
    - Clinical data form
    - Standing orders
    - Adjunctive medications
    - Laboratory supplies
- Clinical data form, EKG, and laboratory results faxed to PCI center cath lab
- Standardized protocol specifies pre-transfer reperfusion option
- Patients transported directly to cath lab, bypass ED
- 30-30-30 rule
    - 30 min total time at initial hospital
        - Written institution-specific STEMI protocol
        - Transfer forms
        - Adjunctive medication
        - One call access to activate CCL at receiving hospital
    - 30 minute inter-hospital transport time
    - 30 minute door-to-balloon at receiving STEMI center
        - Cath lab team activated and completes set-up while patient en route
        - ED and cardiac care unit bypassed for CCL
        - Patient pre-registered based on information faxed from transferring hospital
        - ED available if needed
- Comprehensive feedback and quality assurance plan

- Immediate feedback to community physician and nursing supervisor

North Carolina

- Five regions, urban and rural, comprise system
- All hospitals in each region agreed to have
    - A system in which ED physicians or paramedics activate cath lab in one phone call 24/7
    - Acceptance of STEMI patients regardless of bed availability
    - Leadership team of all personnel and administrators involved with STEMI care
    - Willingness to improve care for STEMI patients
    - Participation on national data registry
    - Partial financial support of regional coordinator
- Coronary perfusion plan established for each hospital
- Overall set of recommendations provided in operations manual
    - Most appropriate system varied from hospital to hospital depending on resources
    - Systematic plans established
        - Common reperfusion plan
        - Single-number activation of cath labs
        - Fibrinolysis at non-PCI center or transfer for PCI depending on anticipated length of transfer
        - ED physician and/or EMT activation of cath lab/reperfusion
        - EMS EKG training programs for pre-hospital EKG

Mayo Clinic

- PCI center and 28 surrounding hospitals within 150 miles
- Regional STEMI protocol
    - Standard order sets with adjunctive therapies for primary PCI and fibrinolysis
    - Single phone call system to activate transfer and cath lab
    - Central communication center to select fastest mode of transport
    - Helicopter protocol
    - Bypass of PCI center ED
- PCI center
    - EKG within 10 minutes of hospital arrival
    - ED department activation of cath lab with one call
    - Cath lab readiness within 30 minutes
    - Prospective data collection and feedback

Gross and Le May studies (200&, 2006): EMT STEMI diagnosis with field EKG, bypass hospitals to PCI center, cardiologist and cath team activated by ED physician or EMT, evaluation by cardiologist in ED or area adjacent to cath lab, cath team ready if diagnosis confirmed

Bradley, E et al 2006 find use of pre-hospital EKG and activation of cath lab by ED physician lead to faster door-to-balloon times

References:

Please refer to TCD bibliography.